
CHAPTER SEVEN

GUIDELINES ON AIR HANDLING & AIR MONITORING SYSTEMS

To date, most terrorist attacks have involved small arms or conventional explosives. There is, however, increasing evidence of terrorist interest in unconventional weapons. The intentional release of hazardous material is particularly dangerous in urban environments due to the dense concentrations of people and buildings. This chapter addresses the threats from chemical, biological, and radiological (CBR) weapons and recommends certain detection and mitigation methods. Specifically, it presents general guidelines for High Tier buildings pertaining to HVAC systems. It covers access to HVAC systems, as well as HVAC system air intakes, filtration, and ventilation. The chapter also covers detection technologies as they relate to CBR threats. Because this field is rapidly changing, the NYPD's recommendations related to countering CBR threats will continue to evolve as new technologies and countermeasures emerge.

CBR Threats

Chemical, biological, and radiological weapons have distinct characteristics and carry varying consequences. Each category of weapon encompasses a wide variety of agents. In general, chemical weapons are extremely lethal, highly toxic poisons that move in a gaseous or liquid form. Chemical agents are especially dangerous when deployed in confined spaces. For example, whereas cyanide vapor released in an open space may be diluted rapidly, resulting in minimal impact, the same amount of vapor released in an enclosed space may be lethal.¹

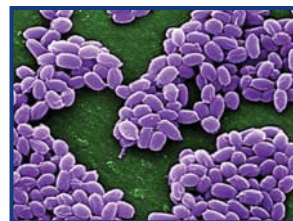
Biological weapons are pathogenic micro-organisms or biologically produced toxins which cause serious illness or death. Biological attacks involve the deliberate release

of large quantities of infectious organisms against a target population, generally as an aerosol (i.e., a collection of small particles suspended in the air). A few kilograms of effectively disseminated biological agents can cause tens to hundreds of thousands of casualties.² However, without an effective system for aerosol dissemination, biological weapons cannot easily cause casualties on a mass scale.

Radiological weapons are often grouped with nuclear weapons but are fundamentally different. Nuclear weapons release vast amounts of energy either through nuclear fission or through a combination of fission and fusion. If a nuclear weapon were deployed in a dense, urban environment, the damage would be catastrophic.³ Radiological weapons disperse radioactive substances but do not produce a nuclear explosion. The simplest radiological weapons would consist of a conventional explosive surrounded by radioactive material; this is commonly referred to as a “dirty bomb.” Crude radiological weapons are unlikely to produce mass casualties but could create public fear if deployed.

Although terrorist groups have to date failed to successfully deploy a radiological weapon, they have attempted to acquire, and in a few cases have successfully deployed, chemical and biological weapons. For instance, in 1995, members of the Aum Shinrikyo religious cult carried out five coordinated chemical attacks in Tokyo, Japan. The group dropped plastic bags filled with sarin solution, punctured to allow the agent to leak into train cars and station platforms. The incident killed a dozen people and injured several thousand.⁴ Six years later, a series of letters containing *Bacillus anthracis* (the causative agent of the disease anthrax) were sent to addresses in New York City, Washington, D.C., and Florida, including to several news outlets and two U.S. Senators. Over the course of two months, exposure to *B. anthracis* killed five people and sickened nearly two dozen.⁵

Al Qaeda has shown interest in the use of unconventional weapons. In 2002, the U.S. military discovered a laboratory in Kandahar, Afghanistan, in which Al Qaeda is believed to have been producing *B. anthracis*.⁶ In 2003, a Saudi cleric affiliated with Al Qaeda issued a *fatwa* declaring the permissibility of the use of weapons of mass destruction against



B. anthracis spores

“infidels.”⁷ In another instance, Al Qaeda attempted to produce a compact chemical dispersal device called a “*mubtakar*” for disseminating cyanogen chloride and hydrogen cyanide in an enclosed space.⁸ In 2007, insurgents in Iraq used cylinders of chlorine in conjunction with explosive devices in at least ten attacks.⁹

HVAC Systems

HVAC systems are important tools for limiting the effects of a CBR attack since they are capable of handling, filtering, and treating air after an event. Effective HVAC-system design for High Tier buildings requires consideration of how best to prevent the intake of contaminated air; how to filter contaminated air once it is introduced; how to control and ventilate contaminated air; and how to contain air within certain zones of a building.

Access

The NYPD recommends that owners of High Tier buildings locate HVAC system controls away from public areas, such as lobbies, loading docks, or mailrooms.¹⁰ System designers should also position return-air grilles in locations that are in view of security personnel but inaccessible to the public.¹¹ If the building’s HVAC system is on the roof, the NYPD recommends the use of magnetic contacts at roof access points as part of an intrusion-detection system to detect unauthorized entry.¹² As covered in detail in Chapter Five, owners of High Tier buildings should restrict access to mechanical rooms housing HVAC systems to authorized and credentialed personnel and strictly limit access to HVAC schematics, which are considered sensitive security documents.¹³

Air Intakes

Industry standards consistently recommend that designers place air intakes above ground to guard against the introduction of CBR agents into the building. However, the prescribed optimal height for air intakes varies by agency. The New York City Mechanical Code requires air intakes to be positioned at least 20 feet above ground level.¹⁴ At a minimum, the NYPD recommends that owners of High Tier buildings position air intakes higher than the second story of a building.¹⁵ If feasible, owners of High Tier buildings should position air intakes 100 feet above ground level or higher, to protect against the threat from a ground release of a

CBR agent propelled upward by the “urban street canyon effect,” common in urban environments with tall skyscrapers.¹⁶ For existing buildings, designers may be able to retrofit at grade air intakes with ducts to raise intake points.¹⁷ Finally, the NYPD recommends that owners of High Tier buildings ensure that all intakes are covered with non-magnetic screens to prevent the attachment or entry of hazardous objects.¹⁸

Filtration

High efficiency filtration can provide a certain level of defense against unconventional terrorist threats. HVAC systems can capture hazardous particulates in their filters, including some CBR agents, and thus prevent dissemination throughout the building. Accordingly, the NYPD recommends that owners of High Tier buildings invest in advanced filtration systems that can afford a measure of protection against CBR threats.¹⁹

Chemical materials generally move in a gaseous form and necessitate adsorption filters; these filters operate through a chemical process which attracts the hazardous molecules to activated carbon within the filter.²⁰ Airborne biological and radiological materials move in the form of small particulates, and thus require solid particle filters; these filters operate by capturing particles that are smaller than a certain pore size.

Particle filters are assigned a value called the minimum efficiency reporting value (MERV) rating. Higher MERV ratings reflect more efficient and effective filters. For example, a MERV-13 filter captures less than 75 percent of particles between the size of 0.3 and 1.0 micron, whereas a MERV-16 filter captures greater than 95 percent of particles within that range.²¹ The NYPD recommends that owners of High Tier buildings incorporate solid particle filters with high MERV ratings.²² In particular, High Tier buildings should use multiple MERV-16 filters, at least one MERV-17 filter, or a high-efficiency particulate air (HEPA) filter.²³ MERV-17 filters and HEPA filters are 99.97 percent effective at removing particulate matter greater than 0.3 micron in size, including biological agents such as *B. anthracis*.²⁴ However, hazardous particles less than 0.3 micron in size are likely to pass through the recommended filters.

Ultraviolet (UV) radiation technology can be coupled with filtration systems to maximize the effectiveness of HVAC systems in eliminating hazardous particles.²⁵ Biological agents are vulnerable to UV radiation, because a certain level of exposure is lethal to micro-organisms. Although HVAC systems equipped with UV technology may not effectively mitigate every CBR threat scenario, owners of High Tier buildings should nonetheless consider their use, when feasible.²⁶ UV radiation technology may be more expensive than other particle-eliminating systems; therefore, the NYPD recommends that owners of High Tier buildings analyze the costs and benefits of such solutions.

Ventilation and Emergency Response Plans

The NYPD recommends that owners of High Tier buildings prepare protocols to manage CBR release events through a process of detection, assessment, and fan and damper operations. This process should exploit fan-system zoning and manipulate supply, return, and pressurization fans to isolate airborne hazards and establish areas of refuge. As an additional precaution, owners of High Tier buildings should install dedicated and independent HVAC systems for interior spaces and public areas, such as lobbies, loading docks, cargo-screening areas, and mail rooms.²⁷ In the event of a CBR attack, these segregated HVAC systems may reduce the chance of contaminants spreading throughout the building.

CBR agents have distinct characteristics and thus necessitate distinct ventilation responses in the event of an attack. Therefore, owners of High Tier buildings should devise comprehensive and detailed response procedures that are guided by specific CBR threats. The NYPD recommends that owners of High Tier buildings ensure that building managers prepare instructions that indicate when building operators should shut down HVAC systems or increase air circulation in certain zones.²⁸ Additionally, redundant emergency HVAC controls should be readily available in High Tier buildings for trained personnel to control air flow, if necessary, and to enhance survivability.²⁹ In emergency situations, system operators should take direction from emergency response personnel.

The NYPD recommends that owners of High Tier buildings use HVAC systems capable of rapidly ventilating interior air to the outside if the threat necessitates such a response.³⁰ Building owners should coordinate occupant evacuation plans

with emergency HVAC protocols to ensure that ventilation systems do not pump contaminated air into evacuation areas in the event of an attack.

CBR Detection Systems

An effective strategy for countering CBR threats requires early and reliable detection capabilities. Accordingly, the NYPD recommends that owners of High Tier buildings monitor chemical, biological, and radiological detection technologies and carefully study the benefits of implementing such systems.³¹ Unfortunately, there is currently no all-inclusive or standardized CBR detection suite; building owners must make individual decisions about whether to purchase chemical, biological, and radiological detectors, and must do so with the knowledge that these technologies are rapidly evolving. When possible, owners of High Tier buildings should attempt to have the detectors they select certified by a national or independent laboratory and should maintain records of such tests.

For chemical agents, owners of High Tier buildings should consider installing detection technology in air ductwork systems and remote sensing systems in areas with large occupancy populations.³² Additionally, optical sensors, such as CCTV cameras, may be able to detect gross symptomology immediately following a chemical attack. For radiological agents, owners of High Tier buildings should consider the use of screening technologies such as portal monitors, spatial detectors, handheld detectors, and personal pagers. For biological agents, detection systems are mostly in the research and development stage.³³ The NYPD recommends that owners of High Tier buildings consider the use of effective biological pathogen detectors, as the technology advances and becomes commercially available.

Because releases of CBR agents outside of a building can also affect building occupants, owners of High Tier buildings should consider placing detection technology on the exterior of the building, as well as on the interior. Upon detection, building managers can close off air intake into the building.³⁴ Owners of High Tier buildings employing such technology should notify emergency-response agencies of the location and capability of their outdoor detection sensors.



NYPD CBRNE Information Center

The NYPD recommends that owners of High Tier buildings integrate CBR detection equipment into central security management control and building management systems so that building personnel are immediately notified of intentionally released hazards.³⁵

In all cases, owners of High Tier buildings should inform local law enforcement and first responders of the building's CBR countermeasures and associated emergency protocols.

The threat of CBR terrorist attacks is constantly evolving. The technical expertise required to produce CBR weapons has become increasingly widespread and many of the materials needed to construct these weapons have become more readily available on the open market.³⁶ However, by implementing the most advanced countermeasures available, building owners can prevent casualties and mitigate property damage in the event of a CBR attack.

